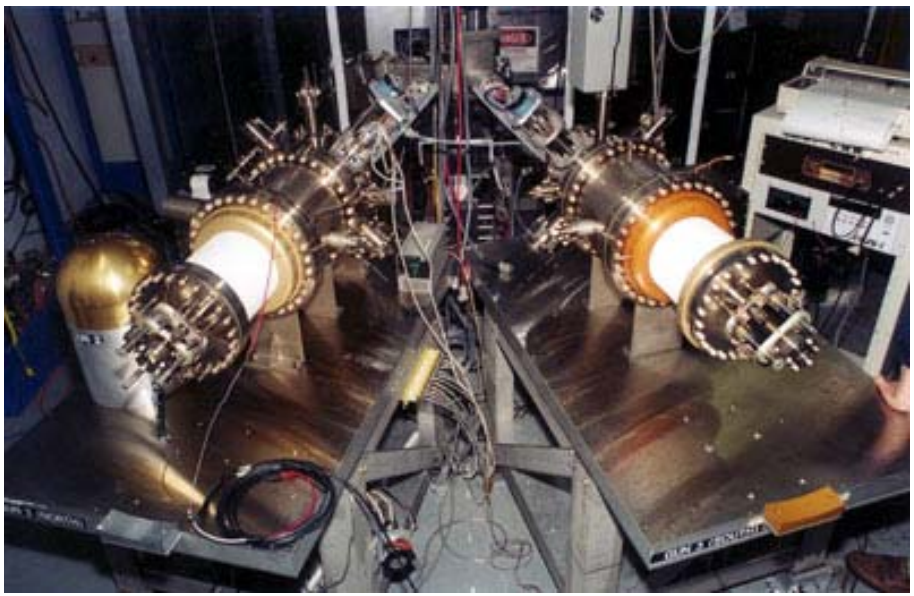
Polarized Source status report

aka The EGG

Maud Baylac



The Electron Gun Group

Jefferson Lab
Newport News, VA
http://www.jlab.org/accel/inj_group

Hall A Parity Meeting
Jefferson Lab
May 10, 2002

Polarized injector guns

- 2 identical horizontal guns installed in 1998
- Gun 2 in use Oct 2000 – Jan 2001, then suffered field emission
- Gun 3 in use Feb 2001 – Mar 2002
- **Since April shutdown, 2 working guns**
- Each gun equipped with

high polarization photocathode

A few numbers

- **QE**

  0.2% at 840 nm => I (uA) ~ P (mW)

  1 % at 770 nm => I (uA) ~ 6 P (mW)

- **Polarization**

  70 to 80 % at cathode

  measured by Mott, Moller, Compton

Lifetime (1/e)

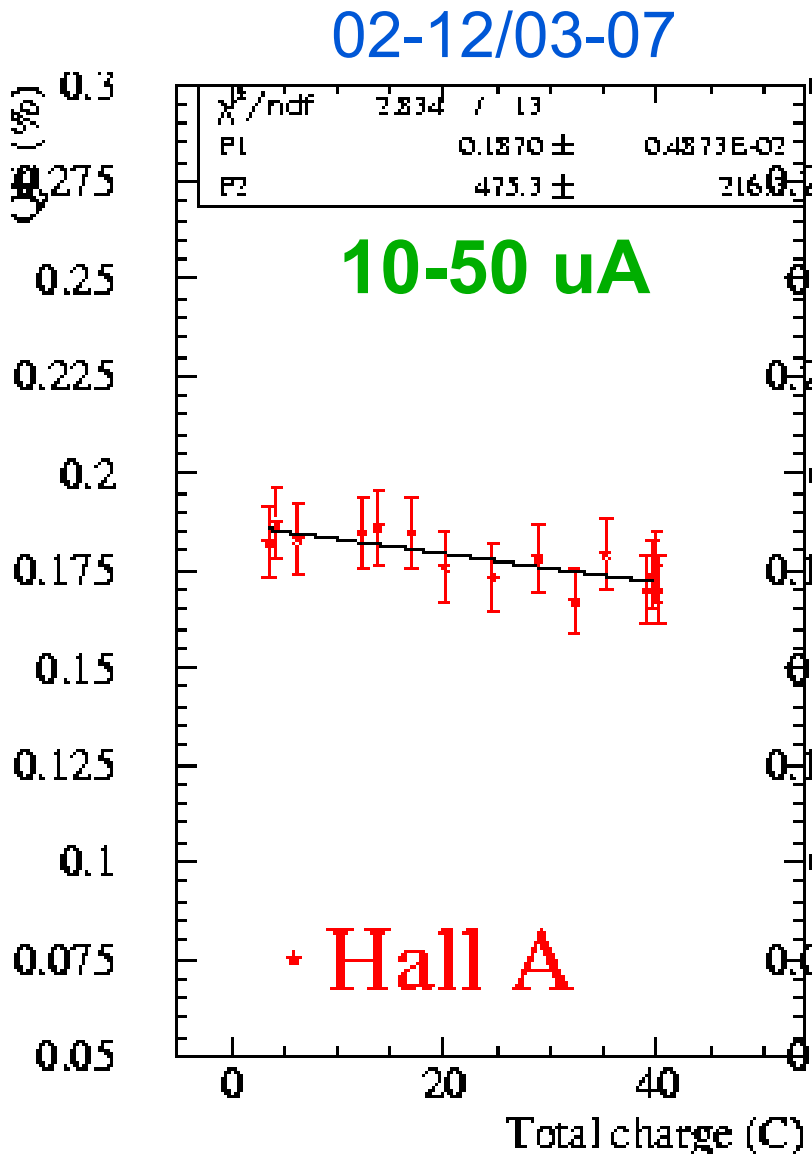
- **Low current : lifetime ~ 600 C**

  beam to 3 halls for 3 months
  with one single activation

- **High current : lifetime ~ 300 C**

  uninterrupted beam for 3 weeks

- **One year with only 3 activations!**



Lasers

- Perfect Laser : 5 W DC diode laser => DC electron beam chopped to get RF structure
  - simple : one single beam, no laser phase
  - light with large emitting aperture => new gun
- Next best thing : 3 lasers, 3 HC adjustment knobs
- Diode :
  - easy, low maintenance, reliable
  - low noise ~ 0.1% @ 30 Hz
  - low power < 100 mW
  - DC light => leakage
  - Original vendor SDL quit selling amps

Lasers (cont.)

- TiSa:

  high power ~ 300 mW

  wavelength adjustable

  high maintenance

  noisy ~ 1% @ 30 Hz

- Immediate future solution :

  diode : low current polarized, high current unpolarized

  commercial TiSa for high current and high Pe

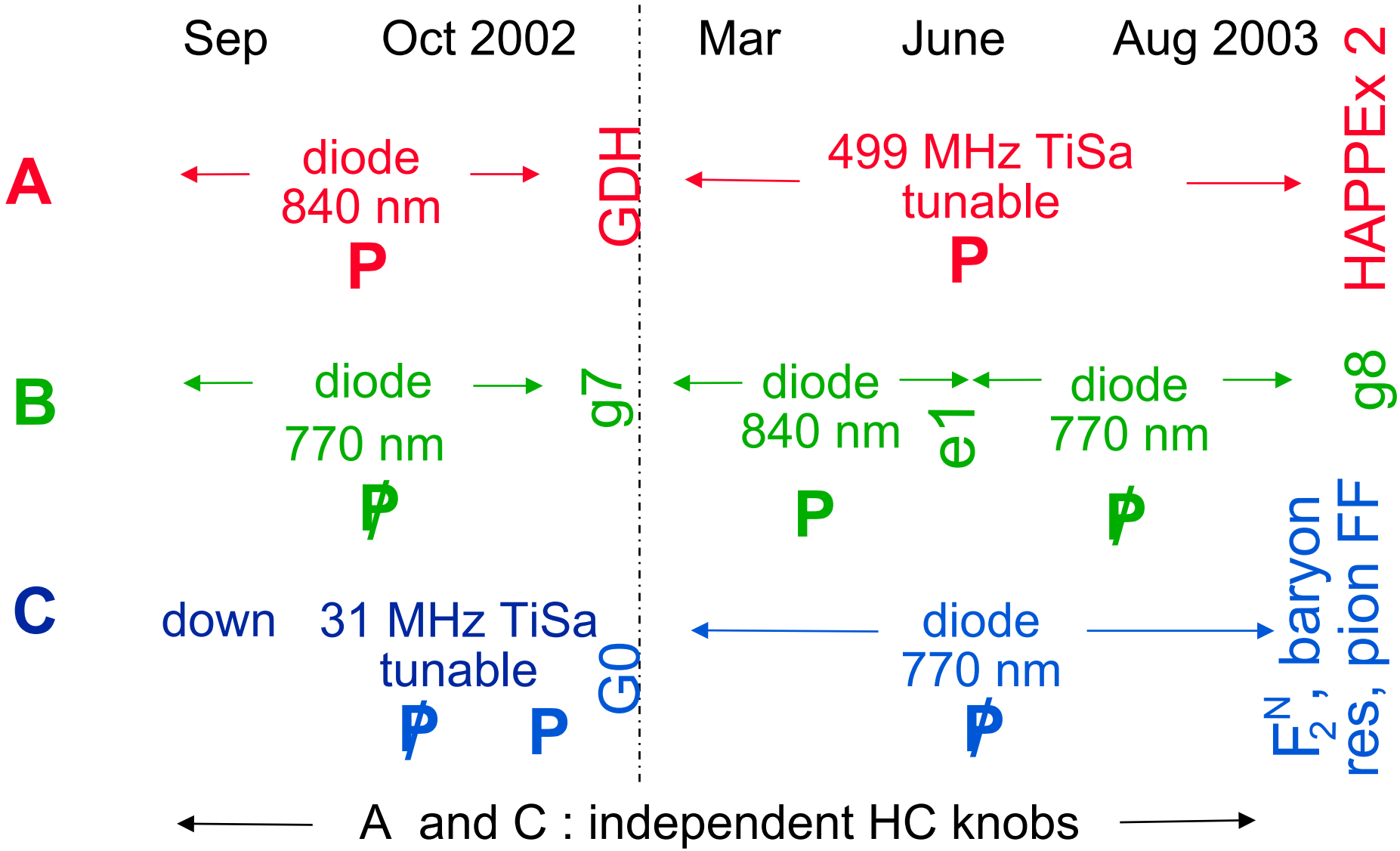
  vendor claims diode-like specs

  G0 : delivered in July

  or improve our homebuilt TiSa

Present setup

Future timeline



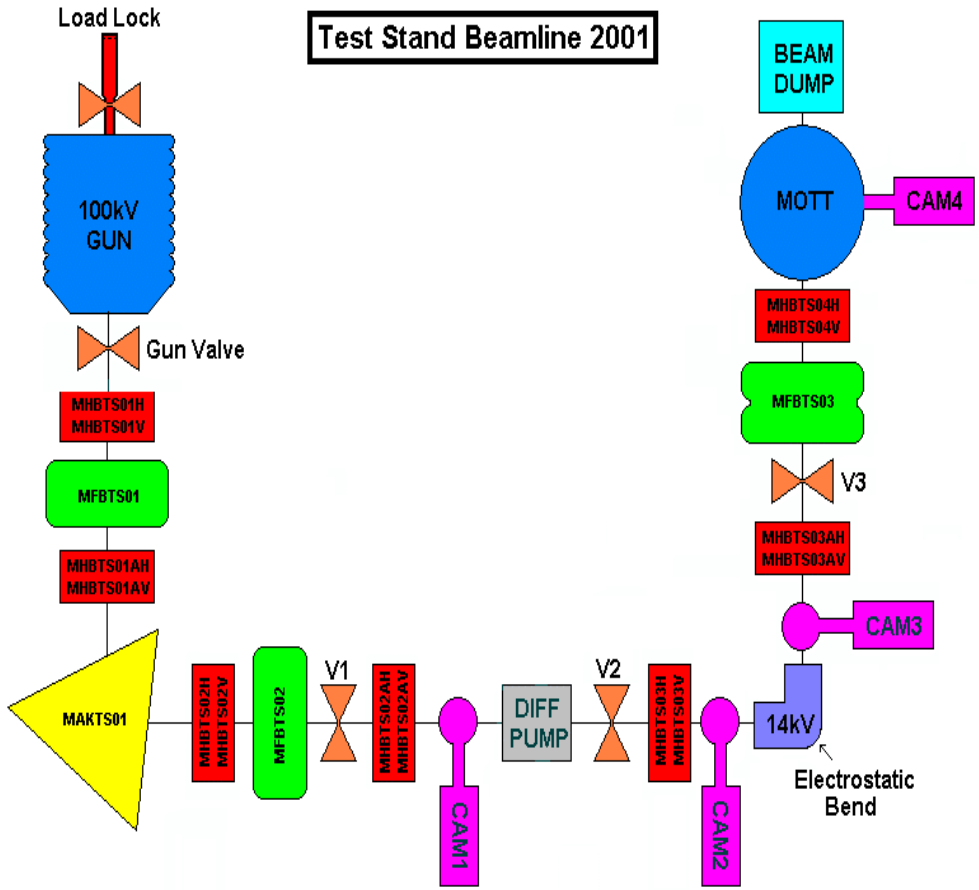
Photocathode research

QE, Pe : always higher

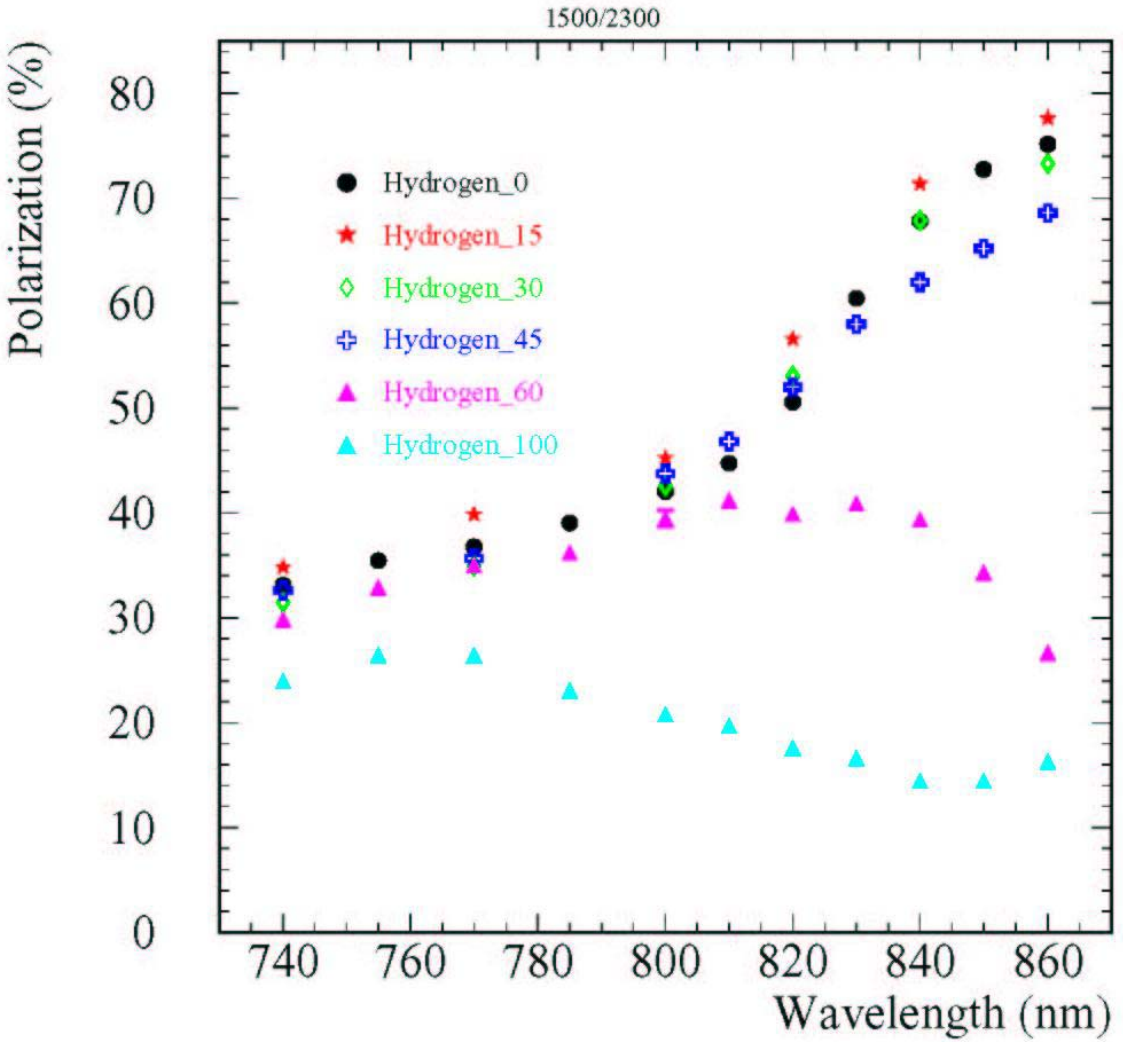
- Study of best chemicals for activation
- Evaluation of new samples
- Study of polarization versus Hydrogen exposure

Hydrogen exposure study

- Strained layer GaAs wafer
- Repeat Hydrogen exposures
- Load to VGun
- Activation (Cs + NF3)
- Run 100 kV beam
- Measurement of
  - QE
  - Polarization



Polarization vs Hydrogen exposure

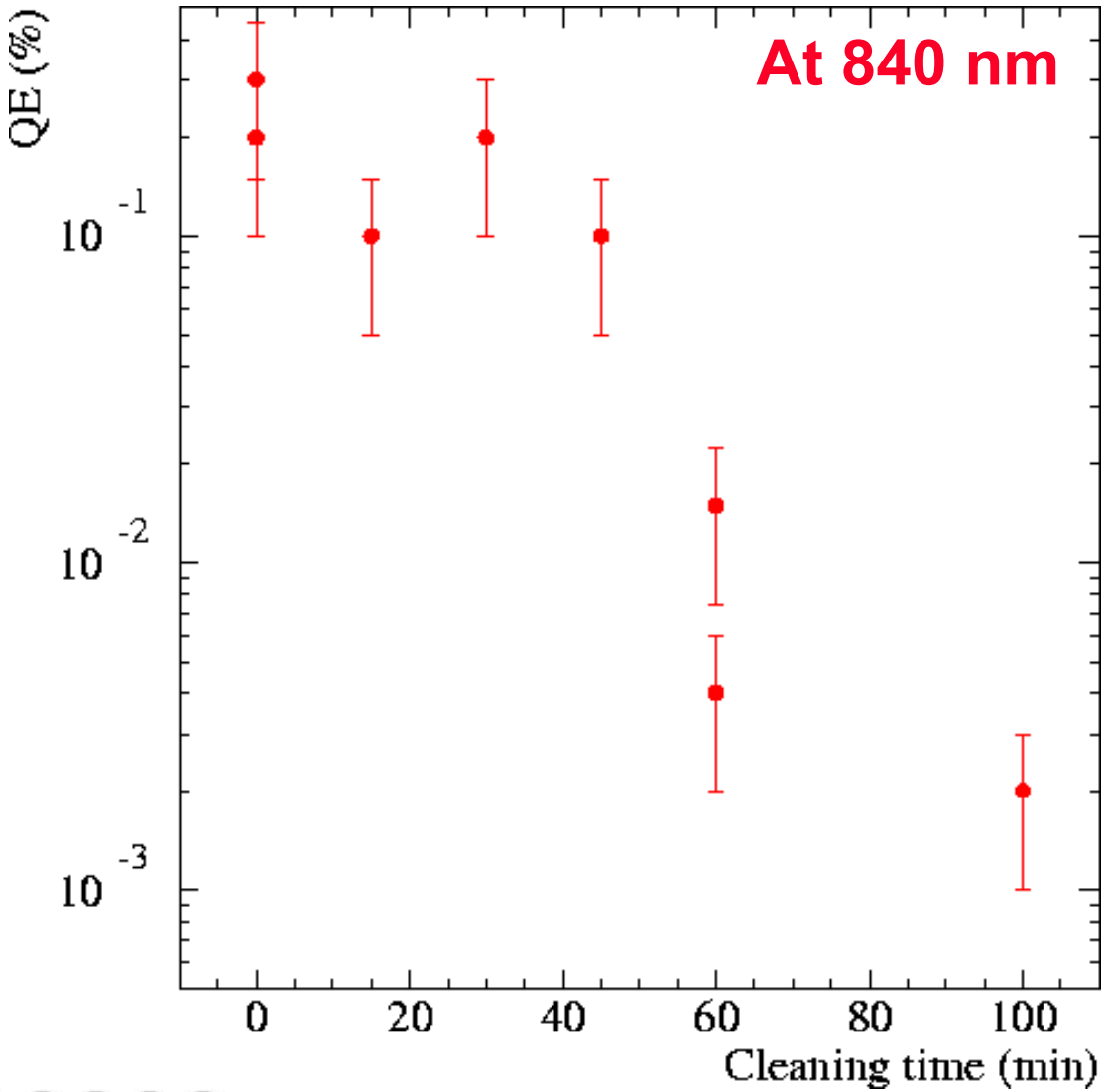


P max ~ 80%

at 860 nm

with 15 min

QE vs Hydrogen exposure



Real effect, or procedure?

Polarization vs Hydrogen exposure : preliminary results

- Small dose slightly increases Pe, high dose kills Pe and QE
- This behavior explains old bad results with same material
- Users now get the highest possible Pe

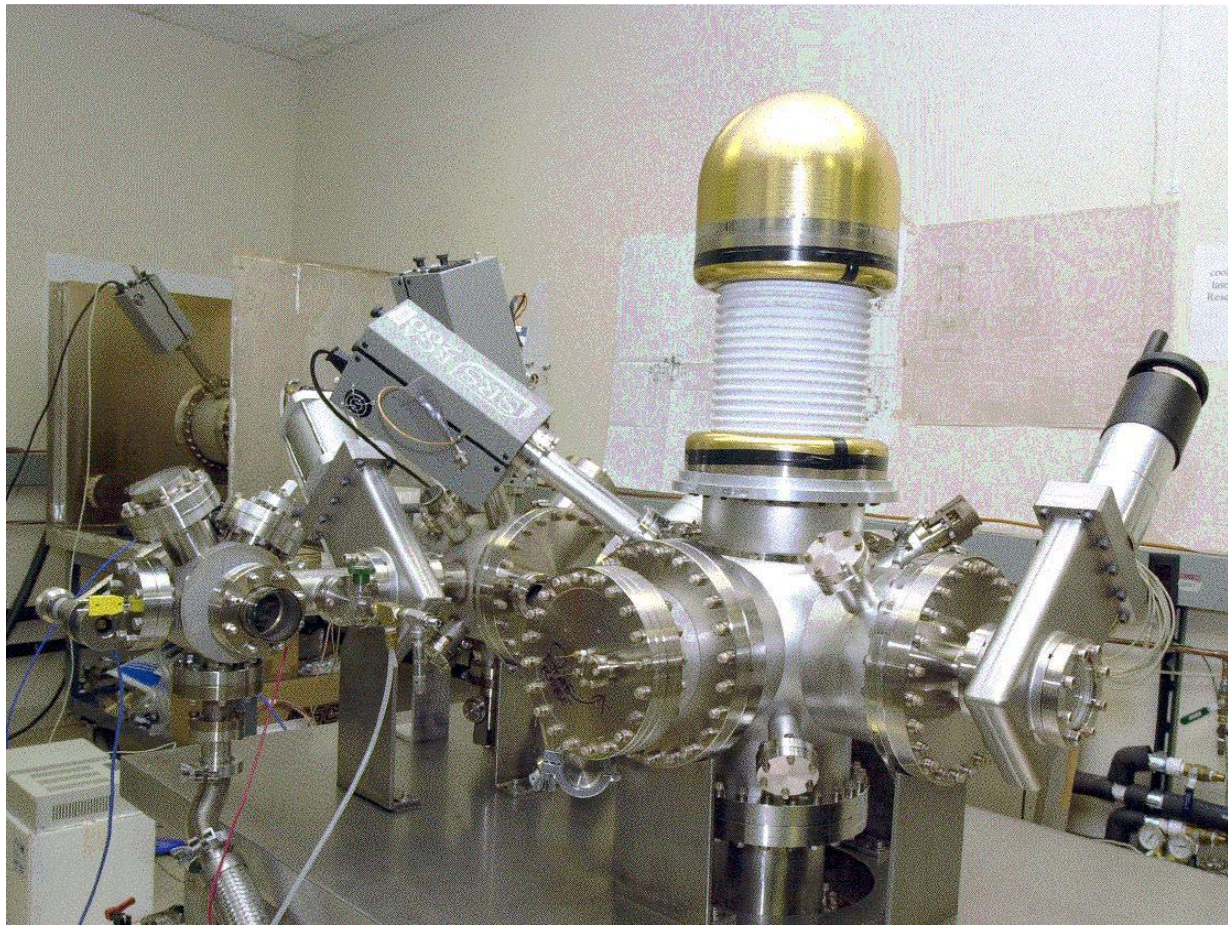
  gun 2 wafer, 15 min H -> **Pe ~ 76 % (Mott)**
- Study continues :

  repeat with strained and bulk
  check QE behavior in another chamber
  improve design : gun, Mott
  model effect, better Hydrogen sources?

=> goal : Pe ~ 85 %

Best Technology Load Lock Polarized Electron Gun

- New generation gun
- Entire cathode prep within the gun
- Change to a new wafer within ~ 8 h (vs 3 days now)
- Moved to the test stand in April, commissioning underway



BTLLPEG studies

- Lifetime

  few mA to a dump

- Emittance
- Helicity correlations
- Polarimetry
- Timescale ~ 1 year

Summary

- Excellent results with guns (Pe, lifetime)
- Laser status :

  GDH : “easy” diode

  G0 / HAPPEx 2 : commercial TiSa to be tested

  HC : Joe’s talk
- Rich photocathode research program in the test cave
- Load-locked gun getting commissioned
- Dealing with Charlie’s departure